

What is claimed is:

1. A method for operating an electromagnetic operating mechanism including a magnet yoke, permanent magnets, an armature, and electromagnetic coil means (L1, L3, L4) by means of a control voltage (Vi) to be applied to the input of a microcontroller-implemented control circuit, including
 - a permanent-magnet assisted electromagnetic pull-in mode against a retaining force upon application of the control voltage (Vi),
 - a subsequent, exclusively permanent-magnetic holding mode while the control voltage (Vi) remains applied, and
 - a drop-out mode, which is provided electromagnetically against the permanent-magnetic holding force and assisted by the retaining force, and which is brought about in that a capacitive charge storage device (C1) charged during the pull-in and holding modes is discharged upon removal of the control voltage (Vi),
 characterized by the following method steps:
 - A) upon application of the control voltage (Vi), resetting and initializing the control circuit and starting the charging of the charge storage device (C1),
 - B) subsequently briefly energizing an auxiliary tripping coil (L4) and a main tripping coil (L3) in an arbitrarily defined order, whereupon, if no current flow occurs through one of the two tripping coils (L3; L4), the control voltage (Vi) is permanently disconnected,
 - C) after detecting a current flow through both tripping coils (L3; L4), however, energizing a closing coil (L1) in order to move the armature to the attracted position, and subsequently de-energizing said closing coil (L1),
 - D) subsequently briefly energizing the auxiliary tripping coil (L4) and the main tripping coil (L3) in an arbitrarily defined order without affecting the armature, whereupon, if no current flow occurs through the auxiliary tripping coil (L4), the charge storage device (C1) is discharged through the main tripping coil (L3) in order to move the armature to the dropped-out position, or, if no current flow occurs through the main tripping coil (L3), the auxiliary tripping coil (L4) is energized in order to move the armature to the dropped-out position, after which, in both cases, the control voltage (Vi) is permanently disconnected,
 - E) after detecting the current flows through the tripping coils (L3; L4), however, starting the method step D, but upon removal of the control voltage (Vi), discharging

the charge storage device (C1) through the main tripping coil (L3) in order to move the armature to the dropped-out position.

2. The method as recited in the preceding claim,
wherein the brief energization of the main tripping coil (L1) in accordance with method step B occurs only when the charge storage device (C1) is in a sufficiently charged state.
3. The method as recited in one of the preceding claims,
wherein the permanent disconnection of the control voltage (Vi) in accordance with method steps B and D occurs through short-circuit tripping.
4. The method as recited in one of the preceding claims,
wherein the brief current flow through the auxiliary tripping coil (L4) in accordance with method steps B and D is detected as a resistive voltage drop (VR6).
5. The method as recited in one of the preceding claims,
wherein the brief current flow through the main tripping coil (L3) in accordance with method steps B and D is detected as a voltage drop ($-\Delta VC1$) across the charge storage device (C1).
6. The method as recited in the preceding claim,
wherein both when the voltage drop ($-\Delta VC1$) is too low or too high, the auxiliary tripping coil (L4) is energized, after which the control voltage (Vi) is permanently disconnected.
7. The method as recited in one of the preceding claims,
wherein in the event that a voltage rise ($+\Delta VL1$) induced on the closing coil (L1) as a result of the brief current flow through one of the two tripping coils (L3; L4) fails to occur, the respective other tripping coil (L3; L4) is energized, if necessary, in order to move the armature to the dropped-out position, and the control voltage (Vi) is necessarily permanently disconnected.
8. The method as recited in one of the preceding claims,

wherein in the event of a failure of the microcontroller, the charge storage device (C1) is discharged through the main tripping coil (L3) in order to move the armature to the dropped-out position.

9. The method as recited in one of Claims 1 through 7,
wherein in the event of a failure of the microcontroller, die auxiliary tripping coil (L4) is energized in order to move the armature to the dropped-out position.
10. The method as recited in one of the preceding claims,
wherein the retaining force is provided by at least one return spring operatively connected to the armature.
11. The method as recited in one of the preceding claims,
wherein the retaining force is provided by at least one further permanent magnet operatively connected to the armature.
12. A circuit arrangement for operating an electromagnetic operating mechanism which is formed by a magnet yoke, at least one permanent magnet disposed on the side of the magnet yoke, an armature, and retaining means exerting a retaining force, including electromagnetic coil means (L1; L3; L4) surrounding the magnet yoke, a control circuit supplied with a rectified control voltage (Vi) applied to its input and containing a microcontroller (MC), and a capacitive charge storage device (C1), where, upon application of the control voltage (Vi), the armature is attracted against the retaining force, assisted by permanent-magnet action, then held exclusively by permanent-magnet action while the control voltage (Vi) remains applied, and when the control voltage (Vi) is removed, the armature drops out with the assistance of the retaining force and against the permanent-magnet holding force through discharging of the charge storage device (C1),
characterized by
 - a trippable permanent interrupting element (DU) for permanent disconnection of the control voltage (Vi) which is capable of being supplied via feed terminals (S1; S2),
 - an auxiliary disabling branch which is formed by the series connection of an auxiliary tripping coil (L4), an auxiliary disabling element (T4), and current-monitoring means (BI4), and is connected to the feed terminals (S1; S2),

- an enabling branch which is formed by the series connection of a closing coil (L1) and an enabling element (T1), and is connected downstream of the permanent interrupting element (DU),
- a main disabling branch which is formed by the series connection of a forward-biased decoupling diode (D8), a main tripping coil (L3) and a main disabling element (T3), and is connected downstream of the permanent interrupting element (DU), the charge storage device (C1) being placed in parallel with the main tripping coil (L3) and the main disabling element (T3),
- voltage-sensing means (BV3) placed in parallel with the charge storage device (C1),
- connections connecting the input side of the microcontroller (MC) to the current-sensing means (BI4), the voltage-sensing means (BV3), and to a control voltage controller (BVi) whose input side is connected to the feed terminals (S1; S2); and connections connecting the output side of the microcontroller (MC) to the switching elements (T1; T3; T4) and to the permanent interrupting element (DU), the microcontroller (MU) being programmed such that it is initialized upon application of a control voltage (Vi), that it briefly closes the auxiliary and main disabling elements (T4; T3) in a predeterminable order without possibly affecting the armature, that it activates the enabling element (T1) in a pulse-controlled manner in order to move the armature to the attracted position, that it subsequently deactivates the enabling element (T1), and that when the control voltage (Vi) is removed, it closes the main disabling element (T3) in order to move the armature to the dropped-out position, but that if the output signal of the current-sensing means (BI4) or of the voltage-sensing means (BV3) fails to appear, it immediately closes the main or auxiliary disabling element (T3; T4) in order to move the armature to the dropped-out position, and that it subsequently trips the permanent interrupting element (DU).

13. The circuit arrangement as recited in the preceding claim,
wherein the permanent interrupting element (DU) is formed by a short-circuit protective device (F1) and a downstream short-circuit switching element (T6), the short-circuit protective device (F1) being connected to one of the feed terminals (S1).
14. The circuit arrangement as recited in the preceding claim,

wherein an active low-pass filter (AT) is connected on its input side to the closing coil (L1) and on its output side to the short-circuit switching element (T6) in such a manner that a charging capacitor (C5), which discharges or charges when the enabling element (T1) is blocked or open, respectively, closes the short-circuit switching element (T6) when a predetermined charge voltage is reached.

15. The circuit arrangement as recited in one of the Claims 12 through 14, wherein the current-monitoring means (B14) are formed by a current-sensing resistor (R6) and a first amplifier circuit (IV21) originating at said current-sensing resistor (R6).
16. The circuit arrangement as recited in one of the Claims 12 through 15, wherein the voltage-sensing means (BV3) include a high-pass filter (C2-R21) connected to the charge storage device (C1), and further include a second amplifier circuit (IV12) which originates at the high-pass filter (C2-R21) and is connected to the microcontroller (MC).
17. The circuit arrangement as recited in the preceding claim, wherein the voltage-sensing means (BV3) include a third amplifier circuit (IV11) which originates at the charge storage device (C1) and is connected to the microcontroller (MC).
18. The circuit arrangement as recited in one of the Claims 12 through 17, wherein the closing coil (L1) has connected thereto an activatable free-wheeling circuit (FL) and further voltage-sensing means (BV1), which detect a voltage rise (+ ΔV_L1) induced during the brief closing of the main tripping coil (L3) and/or the auxiliary tripping coil (L4) and carry said voltage rise (+ ΔV_L1) to the microcontroller (MC), and, if the voltage rise (+ ΔV_L1) fails to occur, the microcontroller (MC) closes the auxiliary disabling element (T4) or the main disabling element (T3) in order to move the armature to the dropped-out position, and then trips the permanent interrupting element (DU).
19. The circuit arrangement as recited in one of the Claims 12 through 18, wherein at least one return spring operatively connected to the armature is provided as a retaining means.

20. The circuit arrangement as recited in one of the Claims 12 through 18,
wherein at least one further permanent magnet operatively connected to the armature is
provided as a retaining means.